

THE DESIGN AND DEVELOPMENT OF A COMPUTERIZED ATTENTION-TRAINING GAME SYSTEM FOR SCHOOL-AGED CHILDREN

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ABSTRACT

A computerized attention-training game system has been developed to support attention training for school-aged children. The present system offers various types of computer games that provide training in different aspects of attention, such as selective attention, sustained attention, and divided attention. The N-tier architecture of the Web-based applications was applied for the development of this system. Children can access the system to play interactive games in a Web-based environment by using smart phones, tablet computers, or personal computers. A complete set of training information is collected in which the system provides a training portfolio mechanism to record the training progress and performance of the player. Children may benefit with the challenging features of attention demands during game-playing and the observer may gain detailed information of the training process. The game scenario helps motivate children to practice attention tasks with interactive play and immediate feedback.

KEYWORDS

Computer games, Attention training, Training portfolio, Attention assessment

1. INTRODUCTION

Attention is very important to the progress of children's memory and learning skills because it affects the development of cognition. Therefore, attention training is considered an effective approach to improving the cognitive development of school-aged children. The major principle is that repeated practice of attention tasks can produce adaptations in the underlying neuroanatomical networks linked to these processes and can improve the attention performance (Kerns, et al, 1999; Posner and Raichle, 1994). Attention training employs different kinds of cognitive-behavioral tasks (e.g., self-monitoring, self-reinforcement, neurofeedback or biofeedback, and cognitive training methods) to train various types of attentions (e.g., selective, sustained, and divided attention) and to improve concentration in different cognitive tasks (Lévesque et al, 2006; Sohlberg and Mateer, 1989; Zoefel et al, 2011). Klimkeit et al (2004) investigated the development of attention and executive functions on normal children aged between 7–12 years old (n = 40). Their study results revealed that the largest improvement in selective attention and executive functions occurred between the ages of 8–10 years and rose to a plateau in performance between 10–12 years of age.

Computer-based training uses computer programs to coach learners to achieve better performance by employing cognitive strategies and processing. There are several potential benefits of the computer-based training approach, including the ability to train anywhere and anytime, cost-effective, and easy control of the training. In addition, computer and video games also facilitate participation and practice in a personalized training environment towards a successful experience, which may be impossible in real life (Verenikina et al, 2003). Using computer games as training methods can have several advantages due to the interactive elements of computer games, along with the computer's function to present multiple types of media. Therefore, games were utilized as an interesting and motivating environment of attention training, and may offer different kinds of simulated situations (such as iterated practices of attention-cognitive operations) to improve the cognitive performance during attention training.

The purpose of this paper presents the computerized attention-training game system, which is targeted at school-aged children to improve the performances of the visual attention and working memory. The game-based attention training system can provide children not only with fun scenario games but also with exercise to practice attention training.

2. DESIGN AND IMPLEMENTATION

The architecture of the present system consists of five modules: a user interface module, user profile management module, game management module, training portfolio module, and performance management module. The user interface module includes three different interactive interfaces for children, instructors, and administrators. The user profile management module mainly stores the user's basic information such as name, age, and education. The game management module is used for the management and integration of different attention training games. The training portfolio module provides users with the information of training progress. Users can query detailed information of their individual responses for each game. Instructors or administrators also can analyze the progress trend regarding an individual user or a group of participants from the data extracted from this module. The performance management module computes and manages the results of individual game playing. The module can provide users with the scores of a single game or the whole game.

Five games have been developed in the system (see Figure 1) and a series of attention-training tasks, such as selective attention, sustained attention, and divided attention, are involved in each game. For selective attention training in the game, the visual stimuli included a group of animals, such as sheep, cows, chickens, ducks, and pigs, which are placed in a farm where the player has to help the farmer identify the chicken from the other animals (i.e., leading the chicken out apart from the other animals in the farm). These animals might have similar features in color and shape (such as chickens and ducks) or different features (such as chickens and cows) to distinguish the level of selective difficulties in the same game (see Figure2). Between different game levels, animals can be maintained in the farm in a lower game level or moved to a different spot in a higher level. The moving targets increase the difficulty for the player to capture the target animal in the farm. Similar to a common video/computer game, a visual and audio feedback will appear showing correct, wrong, or missing responses after each response during the game.

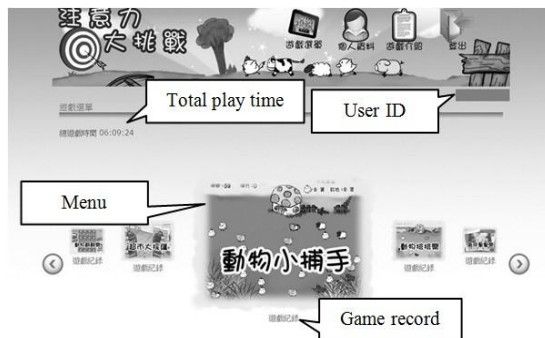


Figure 1. Game menu

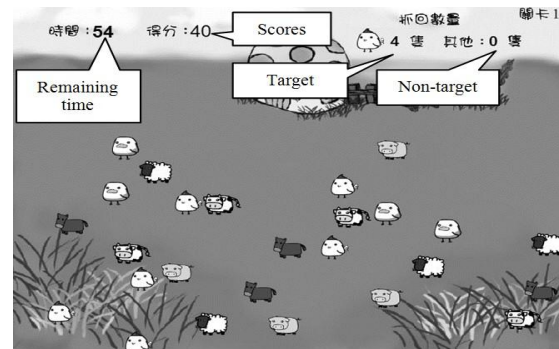


Figure 2. Chicken catcher

This system also provides a training portfolio mechanism to manage players' training progress. School children (players) or teachers can access the record in the training games, such as frequencies, scores, response types (correct, error, or omission), and play time for each program, to keep track of their session performances and training progresses through sessions.

The implementation of the system includes JavaScript and PHP as script languages, Flash as an authoring tool, Apache as a web server, and MySQL as a database. Training progresses and session performances are recorded in MySQL database. The database contains three kinds of relational tables including user profiles, portfolio data, and result data.

3. CONCLUSION

This study proposed a computerized attention-training game system to train attention-related function in children. The Web-based applications own the merit of "anytime and anywhere accessibility" for attention training practice at home, school, and clinical settings. To evaluate the performance of attention training in the present system, we are currently conducting experimental sessions of attention training in school-aged children to verify the efficacy of the system.

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